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(54) **An easy to open package.**

(57) An easy to open package, which package is resistent to thermal treatment, is obtained by vacuum skin packaging wherein an article is sealed between a lower and an upper thermoplastic web, the lower web having a first seal layer on its contact surface which first seal layer comprises a mixture of ethylene/vinylacetate, polybutene and polypropylene, the upper web consisting of an irradiated multi-layer film having a second seal layer on its contact surface which second seal layer is selected from the group comprising an ionomer resin and high density polyethylene.

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The invention relates to an easy to open package wherein an article is sealed between upper and lower thermoplastic webs. More specifically the invention is directed to a package which is tightly sealed and will not be easily destroyed by the usual handling during shipment and storage but which may be easily opened by manually peeling apart the upper from the lower web of the package.

A wide variety of products, especially food products like meat, sausages, cheese and the like are being offered in visually attractive packages made from two thermoplastic webs using the thermoforming process, the vaccum skin packaging process or other methods. The lower web is usually heated and deepdrawn to the desired shape, thus forming a receptacle for the article to be packaged.

In the thermoforming process the upper web is drawn over the article by vacuum and is sealed to the peripheral flange-like edges of the lower web or support using heated sealing bars or sealing platens, usually in the form of a sealing frame.

In the vacuum skin packaging method the upper web is heated, molded down upon and around the product and against the support, the space between the heated upper film and the support having been evacuated. The upper heated film thus forms a tight skin around the product and is sealed to the support by differential air pressure (atmospheric pressure outside versus vacuum inside of the package).

With these processes the problem is encountered that the upper film is sealed so strongly to the support that it is difficult to separate the two webs and to open the package. An easy to open package comprising two thermoplastic webs safely sealed together should be easily openable when manually pulling apart the two webs, normally starting from a point like a corner of the package where the upper web has not been sealed to the support or where the lower web is provided with a cut. In this manner the use of scissors, a knife or other devices to open the package can be avoided.

A solution to this problem has been provided in Proprietor's EP-B-192 131 describing an easy to open package with a seal layer comprising

i) an ionomer having a melt flow index of less than 5, and

ii) a modified ethylene/vinylacetate copolymer having a substantially higher melt flow index whereby the melt flow indices of the two polymers in the seal layer differ by at least 10.

When applying this concept to packages made by the vacuum skin packaging process, very satisfactory seals are obtained. However, further solutions of this problem would be very useful in order to provide other alternatives.

The seal layer on the bottom web is also subjected to a thermal treatment prior to the sealing operation when the lower web is heated and deepdrawn during the packaging process which heat treatment may change the properties of the seal layer on the lower or bottom web.

The vacuum skin packaging method requires as top web an irradiated multi-layer film in order to have satisfactory temperature stability and heat shrinkability properties. This means that the seal layer on the top web will also be subjected to the irradiation and it is therefore necessary to find a combination of seal layers in which

- the seal layer on the lower web will not be adversely affected by heating,
- the seal layer on the top web will not be adversely affected by either heating or irradiation, and
- the finished seal will have satisfactory heat resistance, seal strength, and good ageing properties and will yet provide the desired easy open feature upon peeling.

US-A-5,023,121 discloses a coextruded film with peelable sealant for use in a thermoforming process in which a perimeter seal is applied by a descending seal platen (column 4, lines 30/31). By this thermoforming process an easily opened package is obtained from

a) a first web including a sealant layer comprising a blend of polybutene and polypropylene and a third polymeric material selected from the group comprising

i) ethylene vinylacetate copolymer

ii) low density polyethylene

iii) linear low density polyethylene and

iv) ionomer resin, and

b) a second web with a sealant layer consisting of a polymer selected from the group consisting of ethylene/vinylacetate copolymer, low density polyethylene, linear low density polyethylene, ionomer, and mixtures thereof,

c) an additional layer bonded to the sealant layer of the first web comprising a polymeric adhesive.

In the case of the use of an ionomer as a blending material in the sealant layers, it is necessary to employ it in both sealant layers in order to provide a good peelable seal in the final pachage (col. 8, lines 22 to 26).

It has now surprisingly been found that in a vacuum skin packaging process employing dome temperatures up to about 200 °C a seal with the above mentioned desired properties including the easy to

open feature can be obtained if the seal layers on the lower and upper web, respectively, are very carefully selected while other seal layer combinations taught by the prior art will not give a satisfactory result.

According to the invention an easy to open package which is resistent to thermal treatment is obtained by vacuum skin packaging wherein an article is sealed between a lower and an upper thermoplastic web, said package comprising

a) a lower web having a first seal layer on its contact surface, and

b) an upper web of an irradiated multi-layer film having a second seal layer on its contact surface,

whereby

i) the first seal layer comprises a mixture of ethylene/vinylacetate, polybutene and polypropylene,

ii) the second seal layer is selected from the group comprising an ionomer resin and high density polyethylene.

Preferably the first seal layer on the lower web is a mixture of about 25% by weight of polybutene and polypropylene and of about 75% by weight of ethylene/vinylacetate. A particularly preferred sealant comprises a mixture of polybutene and polypropylene in a weight ratio of about 4:1. The ethylene/vinylacetate copolymer in the first sealant has preferably a vinyl acetate content of about 10 to 20% by weight. Sealants of this type have already been disclosed in US-A-4 665 130 and US-A-4 666 778 (according to which they are sealed to themselves) and are also described in the above mentioned US-A-5 023 121.

Suitable ionomeric resins for the second seal layer on the irradiated top web are acid-modified polyethylene with an acid content of up to 10% by weight and a high degree of ion linking (Zn). Such polymers are commercially available under the tradename SURLYN® (DuPont). Alternatively high density polyethylene having a density of 0.93 g/cm^3 or higher may also be employed as second seal layer.

The total thickness of the seal layer is advantageously in the range of about 5 to 15 µm although thicker layers may also be used in view of the fact that the present seal layers exhibit adhesive failure upon peeling whereas according to the prior art (EP-B-192 131) a relatively thin seal layer is preferred since this will result in a rather smooth breakage due to cohesive failure parallel to the seal layer plane. In this latter case a thicker layer may allow the breakage to occur in different zones or planes of the seal layer so that lose strips and rough surfaces are formed. According to the present invention the first and the second seal layer, respectively, will normally have a thickness between about 2 and 13 µm.

It is important to achieve a good adhesion between the sealant layers and the upper and lower web of the package. Accordingly the innermost layer of the two webs (i.e. their contact surfaces) should be such that they provide good adhesion to the respective sealant layer.

The following examples and comparative examples show that the selection of the sealant layers is critical for the success of the invention. An easy to open seal with constant peel force, low sensitivity to the forming temperature and good resistance to thermal after-treatment (pasteurization) is only obtained if the three component sealant mixture is applied to the bottom web and either an ionomer resin or HDPE are employed as sealant for the irradiated multi-layer top web. The same effect is not obtained if the three-component sealant is used as sealant for the top web or as sealant for both the top and the bottom webs, as suggested by the prior art for packages made by thermoforming (US-A-5,023,121).

The following examples serve to further illustrate the invention.

In order to have identical conditions for the comparison of the behavior of the seal layers, all other structural characteristics and process parameters were held identical or constant, respectively.

The packages were made by the vacuum skin packaging process using a CRYOVAC® VS 44 machine (W.R. Grace & Co.-Conn.). The machine conditions were as follows:

Dome temperature	200 °C
Forming station temperature	85 °C
Tray depth	5 mm
Seal pressure max.	1 bar

A similar performance is expected to be achieved in all machines not equipped with a sealing frame like the MULTIVAC® CD 6000, CD 5600, CD 4000, 1/15 system. The bottom web consisted of a semi-rigid polyvinyl chloride sheet (200 µm thick) with a layer (9 µm) of the sealant to be tested on its contact surface.

As the top web a flexible coextruded multi-layer film was used which consisted of the following layers:
LDPE (40 µm)
Adhesive (3 µm)

EVOH (8 μm)
Adhesive (3 μm)
LDPE (40 μm)
Sealant layer to be tested (6 μm).

All top films were exposed to E-beam irradiation at a dose of 12 Mrad.

The peel tests were run on an ACQUATI® dynamometer at a testing speed of 80 cm/min. A constant peel strength of 250 to 900 g/25 mm is rated "good" whereas lower or higher values, respectively, are rated "not acceptable".

The following sealant compositions were tested:

EVA/PB/PP blend -	75% EVA (12% VA content), 20% polybutene, 5% polypropylene
Ionomer -	Zinc partial salt of Ethylene/methacrylic acid copolymer, MFI 14
HDPE -	High density Polyethylene, MFI 7, density 0,96 g/cm^3
LDPE -	Low density polyethylene, MFI 12, density 0,915 g/cm^3
VLDPE -	Very low density polyethylene, MFI 7, density 0,91 g/cm^3
EVA -	ethylene/vinylacetate copolymer (VA content 5% or 9%), MFI 2,9, density 0,926 to 0,929 g/cm^3
EAA -	Ethylene/acrylic acid copolymer (9,5 % AA), MFI 1,5

The results obtained when using the above sealant layer compositions on either the bottom or the top web are summarized in the following Table 1.

Table 1

Bottom Web	Top Web	Seal strength (g/25 mm)	Easy Openability
EVA/PB/PP	EVA/PB/PP	> 1800	Not acceptable (too strong)
	IONOMER	500 - 850	Good
	LDPE	>1500	Not acceptable (too strong)
	VLDPE	1000 - 1500	Not acceptable (too strong)
	HDPE	500 - 900	Good
EVA (5% VA)	EVA/PB/PP	> 1500	Not acceptable (too strong)
EVA (9% VA)	EVA/PB/PP	> 2000	Not acceptable (too strong)
VLDPE	EVA/PB/PP	> 1500	Not acceptable (too strong)
IONOMER	EVA/PB/PP	40 - 100	Not acceptable (too weak)
EAA	EVA/PB/PE	40 - 80	Not acceptable (too weak)

It will be noted that only the combinations according to the present invention give a seal of the desired easy openability whereas all other seals are either too weak or too strong.

Heat seal layers of the present invention are not influenced by heat treatment of the final package at temperatures normally utilized for pasteurization (+100 °C) according to the enclosed table.

Effect of Heat Treatment on Skin Seal of EVA/PB/PP blend			
Top Sealant	Skin Temp. (°C)	Heat Treatment	Skin Seal (g/inch)
Ionomer	200	None	480-850
Ionomer	200	100 °C, 30 min	470-940
HDPE	200	None	500-900
HDPE	200	100 °C, 30 min	640-900

Claims

1. An easy to open package obtained by vacuum skin packaging wherein an article is sealed between a lower and an upper thermoplastic web which package is resistent to thermal treatment, said package

comprising

a) a lower web having a first seal layer on its contact surface, and

b) an upper web of an irradiated multi-layer film having a second seal layer on its contact surface,

characterized in that

i) the first seal layer is a layer comprising a mixture of ethylene/vinylacetate, polybutene and polypropylene,

ii) the second seal layer is selected from the group comprising an ionomer resin and high density polyethylene.

2. An easy to open package according to claim 1, **characterized in that** the first seal layer is a mixture of about 25% by weight of polybutene and polypropylene and of about 75% by weight of ethylene/vinylacetate.

3. An easy to open package according to claims 1 or 2, **characterized in that** the first seal layer comprises polybutene and polypropylene in a weight ratio of about 4:1.

4. An easy to open package according to anyone of claims 1 to 3, **characterized in that** the ethylene/vinylacetate copolymer has a vinyl acetate content of about 10 to 20% by weight.

5. A method of making an easy to open package which package is resistent to thermal treatment, wherein an article is sealed between a lower and an upper thermoplastic web by vacuum skin packaging, said method comprising use of

a) a lower web having a first seal layer on its contact surface, and

b) an upper web of an irradiated multi-layer film having a second seal layer on its contact surface,

characterized in that

i) as the first seal layer there is used a layer comprising a mixture of ethylene/vinylacetate, polybutene and polypropylene, and

ii) the second seal layer is selected from the group comprising an ionomer resin and high density polyethylene or mixtures thereof.

6. A method of making an easy to open package according to claim 5, wherein the first seal layer is a mixture of about 25% by weight of polybutene and polypropylene and of about 75% by weight of ethylene/vinylacetate.

7. A method of making an easy to open package according to claims 6 or 7, wherein the first seal layer comprises polybutene and polypropylene in a weight ratio of about 4:1.

8. A method of making an easy to open package according to claims 6 to 8, wherein the ethylene/vinylacetate copolymer has a vinyl acetate content of about 10 to 20% by weight.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

DOCUMENTS CONSIDERED TO BE RELEVANT

EP 93250270.1

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US - A - 4 859 514 (FRIEDRICH et al.) * Claims; column 4, line 1 - column 5, line 21 *	1-8	B 32 B 27/30 B 32 B 27/32 B 65 D 30/02 B 65 D 65/40
D,X	US - A - 5 023 121 (POCKAT et al.) * Claims; column 5, lines 5-28; column 6, lines 8-26 *	1-8	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 32 B
B 65 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
WIEN	30-12-1993	WEIGERSTORFER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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